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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/707,031 | 11/17/2003 | Qi Zhao | 134666-1 | 1030 |

41838 7590 05/16/2006

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| EXAMINER |
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KAO, CHIH CHENG G

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| ART UNIT | PAPER NUMBER |
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2882

DATE MAILED: 05/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/707,031

Applicant(s)

ZHAO ET AL.

Examiner

Chih-Cheng Glen Kao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 February 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3,4 and 7-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3,4 and 7-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>2/15/06, 2/21/06</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 2/15/06 has been entered.

Information Disclosure Statement

2. Please note that the information disclosure statements filed 2/15/06 and 2/21/06 are duplicate copies of each other. The references listed in the IDS filed 2/15/06 have already been considered by the Examiner as evidenced by the copy of the 1449 form filed 2/21/06, which has been signed by the Examiner.

Claim Objections

3. Claims 9, 10, and 11-19 are objected to because of the following informalities, which appear to be minor draft errors including grammatical and/or lack of antecedent basis problems.

In the following format (location of objection; suggestion for correction), the following correction(s) may obviate the objection(s): (claim 9, line 2, "the completion"; deleting "the"), (claim 10, line 5, "algorithm and a penalized"; inserting a comma after "algorithm"), (claim 11,

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line 6, “the projection domain”; replacing “the” with - -a- -), (claim 13, line 2, “the completion”; deleting “the”), (claim 14, line 5, “algorithm and a penalized”; inserting a comma after “algorithm”), and (claim 19, last line; inserting a period at the end of the line).

Claims 12 and 15-18 are objected to by virtue of their dependency. For purposes of examination, the claims have been treated as such. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over De Man et al. (“An Iterative Maximum-Likelihood Polychromatic Algorithm for CT”) in view of Little et al. (US 5848115).

5. Regarding claim 1, De Man et al. discloses a method comprising implementing an iterative image reconstruction process of an object (abstract), wherein said iterative reconstruction process utilizes a forward projection (described in Sections II-A and II-B, and page 1002, last paragraph), wherein said forward projection includes using a polychromatic x-ray acquisition model (abstract, lines 3-4).

However, De Man et al. fails to disclose CT metrology.

Little et al. teaches CT metrology (title and abstract).

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It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the method of De Man et al. with the metrology of Little et al., since one would be motivated to make such a modification for more accurate non-destructive evaluation of parts and for providing a great deal of savings in both time and money over previous destructive methods (col. 3, lines 6-11) as shown by Little et al.

6. Regarding claim 3, De Man et al. further discloses wherein using a polychromatic x-ray acquisition model further comprises decomposing a linear attenuation coefficient into a photoelectric component and a Compton scatter component (abstract, lines 6-8), and constraining a relative weight of said photoelectric component and said Compton scatter component based on prior material assumptions (abstract, lines 8-10).

7. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over De Man et al. and Little et al. as applied to claim 1 above, and further in view of Browne et al. ("Maximum-likelihood x-ray computed-tomography finite-beamwidth considerations").

De Man et al. as modified above suggests a method as recited above.

However, De Man et al. fails to disclose incorporating finite x-ray beamwidth considerations, said finite x-ray beamwidth considerations including at least one of: detector point-spread function, detector aperture, detector cross-talk, focal-spot size, off-focal radiation, azimuthal blur, and detector memory effects.

Browne et al. teaches incorporating finite x-ray beamwidth considerations (title), said finite x-ray beamwidth considerations including at least one of: detector point-spread function,

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detector aperture, detector cross-talk, focal-spot size, off-focal radiation (page 5200, col. 2, paragraph 1), azimuthal blur, and detector memory effects.

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the method of De Man et al. as modified above with the finite x-ray beamwidth considerations of Browne et al., since one would be motivated to make such a modification for a marked improvement in image clarity and reduction of artifacts (abstract, line 4) as shown by Browne et al.

8. Claims 7, 8, 10-12, 14-16, and 18-20, are rejected under 35 U.S.C. 103(a) as being unpatentable over De Man (“Iterative Reconstruction for Metal Artifacts in Computed Tomography”) in view of Gindi et al. (“Bayesian Reconstruction of Functional Images Using Anatomical Information as Priors”).

9. Regarding claims 7 and 20, De Man discloses a method comprising during each of a plurality of iterations (fig. 4.1), generating a reconstructed image (fig. 4.1, reconstructed image), transforming said reconstructed image to a projection domain (fig. 4.1, model of the acquisition) so as to generate a calculated sinogram (fig. 4.1, calculated sinogram), and determining at least one of a correction image and a corrected image (fig. 4.1, image correction) based on said calculated sinogram (fig. 4.1, calculated sinogram) and a measured sinogram (fig. 4.1, measured sinogram).

However, De Man fails to disclose constraining an image by utilizing prior outer edge information obtained from a modality in addition to CT.

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Browne et al. teaches constraining an image by utilizing prior outer edge information obtained from a modality in addition to CT (abstract).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the method of De Man with the constraining and prior outer edge information of Gindi et al., since one would be motivated to make such a modification for smoother images (abstract) as implied from Gindi et al.

10. Regarding claim 11, De Man further discloses wherein the iterative reconstruction utilizes a forward projection (page 57, 2nd and 3rd paragraphs, and page 58, last paragraph) in determining said calculated sinogram (fig. 4.1, calculated sinogram).

11. Regarding claims 8 and 12, Gindi et al. further discloses wherein modality in addition to CT further comprises one of: a coordinate measuring machine (CMM) (page 670, col. 2, last paragraph), a micrometer, and a laser-based measurement system.

12. Regarding claims 10 and 14, De Man further discloses wherein said generating a reconstructed image is implemented through at least one of: an iterative filtered back projection (FBP) algorithm (page 67, section 4.9.2), a maximum a posteriori probability (MAP) algorithm, a maximum likelihood (ML) algorithm, an algebraic reconstruction technique (ART) algorithm, an entropy-based algorithm, a least squares (LS) algorithm, and a penalized weighted least squares (PWLS) algorithm.

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13. Regarding claim 15, De Man further discloses wherein forward projection includes using a polychromatic x-ray acquisition model (page 89, section 5.3).

14. Regarding claim 16, De Man further discloses wherein using a polychromatic x-ray acquisition model further comprises decomposing a linear attenuation coefficient into a photoelectric component and a Compton scatter component (page 89, section 5.3, lines 5-7), and constraining a relative weight of said photoelectric component and said Compton scatter component based on prior material assumptions (page 89, section 5.3, lines 7-8).

15. Regarding claim 18, De Man further discloses wherein forward projection includes incorporating scattered radiation considerations (page 89, section 5.3).

16. Regarding claim 19, De Man would necessarily have a storage medium comprising a machine readable computer program code for implementing, and instructions for causing a computer to implement a method (page 7, section 2.2, last line, "comput(eriz)ed").

17. Claims 9 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over De Man and Gindi et al. as applied to claims 8 and 12 above, and further in view of Little et al.

De Man as modified above suggests a method as recited above. De Man further discloses following completion of said plurality of iterations (fig. 4.1) with a resulting completed reconstructed image (fig. 4.1, reconstructed image).

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However, De Man fails to disclose using a reconstructed image to generate a 3D point cloud of a CT image.

Little et al. teaches using a reconstructed image to generate a 3D point cloud of a CT image (col. 1, lines 5-12, and fig. 4, #100, 110, and 128).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the method of De Man as modified above with the point cloud of Little et al., since one would be motivated to make such a modification to more easily compare actual object data to predetermined object data (col. 1, lines 5-12, and fig. 4) as implied from Little et al.

18. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over De Man and Gindi et al. as applied to claim 11 above, and further in view of Browne et al.

De Man as modified above suggests a method as recited above.

However, De Man fails to disclose incorporating finite x-ray beamwidth considerations, said finite x-ray beamwidth considerations including at least one of: detector point-spread function, detector aperture, detector cross-talk, focal-spot size, off-focal radiation, azimuthal blur, and detector memory effects.

Browne et al. teaches incorporating finite x-ray beamwidth considerations (title), said finite x-ray beamwidth considerations including at least one of: detector point-spread function, detector aperture, detector cross-talk, focal-spot size, off-focal radiation (page 5200, col. 2, paragraph 1), azimuthal blur, and detector memory effects.

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the method of De Man as modified above with the finite x-ray beamwidth considerations of Browne et al., since one would be motivated to make such a modification for a marked improvement in image clarity and reduction of artifacts (abstract, line 4) as shown by Browne et al.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chih-Cheng Glen Kao whose telephone number is (571) 272-2492. The examiner can normally be reached on M - F (9 am to 5 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ed Glick can be reached on (571) 272-2490. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Chih-Cheng Glen Kao
Examiner
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